REFRACTIVE BOUNDARY ELEMENTS, DEVICES, AND MATERIALS

TECHNICAL FIELD

The present invention relates to optical elements, methods, or materials for refraction.

BACKGROUND

One common type of refraction is the bending of the path of a lightwave as it crosses a boundary between two media. In conventional optics, Snell's law gives the relationship between the angles of incidence and refraction for wave crossing the boundary:

$n_1 \sin(\Theta_1) = n_2 \sin(\Theta_2)$.

This relationship is shown in Figure 1, where a ray 100 in a first medium 101 arrives at a boundary 102 at an angle Θ_1, as referenced to the normal 104. As the ray 100 crosses the boundary 102, the ray 100 is bent so that it continues propagating as a refracted ray 106 at an angle Θ_2.

While this relatively simple ray optics presentation of refraction is widely accepted, a more thorough examination of refraction involves consideration of propagation of electromagnetic waves and considerations of energy reflected at a boundary. Figure 2A represents this diagrammatically with an incident wave 108 crossing a boundary 110. A portion of the energy is reflected as represented by the wave 112 and a portion of the energy propagates as a transmitted wave 114. As represented by the spacing between the waves, the wavelength of the transmitted wave 114 is shorter than that of the incident wave 112, indicating that the refractive index n_2 experienced by the transmitted wave 114 is higher than the refractive index n_1 experienced by the incident wave 108.